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(REV. 5-93)

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER
2345/127

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
09/530389

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED:
~~PCT/EP99/05972~~ PCT/EP99/05972	(14.08.99) 14 August 1999	(14.08.98) 14 October 1998

TITLE OF INVENTION
METHOD FOR INSTRUMENTAL VOICE QUALITY EVALUATION

APPLICANT(S) FOR DO/EO/US
BERGER, Jens

Applicants herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
    ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: International Search Report and PCT/RO/101.

EXPRESS MAIL NO. EL178106604US

U.S. APPLICATION NO. If known, see 37 C.F.R.1.5	INTERNATIONAL APPLICATION NO. PCT/EP99/05872	ATTORNEY'S DOCKET NUMBER 2345/127

17. ☒ The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):

Search Report has been prepared by the EPO or JPO $840.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) ... $670.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $760.00

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $970.00

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $96.00

				CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 840.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	8 - 20 =	0	X $18.00	$ 0	
Independent Claims	1 - 3 =	0	X $78.00	$ 0	
Multiple dependent claim(s) (if applicable)			+ $260.00	$ 0	
TOTAL OF ABOVE CALCULATIONS =				$ 840.00	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$	
SUBTOTAL =				$ 840.00	
Processing fee of $130.00 for furnishing the English translation later the ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$ 840.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$	
TOTAL FEES ENCLOSED =				$ 840.00	
				Amount to be: refunded	$
				charged	$

a. ☐ A check in the amount of $________________ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 11-0600 in the amount of $840.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Kenyon & Kenyon
One Broadway
New York, New York 10004

SIGNATURE

Richard L. Mayer, Reg. No. 22,490
NAME

7/27/00
DATE

277273

[2345/127]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: BERGER, Jens

SERIAL NO.: to be assigned

FILED: herewith

TITLE: METHOD FOR INSTRUMENTAL VOICE QUALITY EVALUATION

ART UNIT: not yet known

EXAMINER: not yet known

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Please amend the above-identified application before a first consideration on the merits as follows:

IN THE DRAWINGS

Please replace Figs. 2a, 2b and 3 with the amended Figs. 2a, 2b and 3 submitted herewith.

IN THE TITLE

Please amend the title to read --METHOD FOR DETERMINING SPEECH QUALITY USING OBJECTIVE MEASURES--.

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IN THE SPECIFICATION

On page 1, line 1, change "Preliminary Remarks" to --Field of the Invention--.

On page 1, line 3, before "invention" insert --present--.

On page 1, line 6, change "(undisturbed signal)" to --, or undisturbed signal--.

On page 1, before line 8, insert --Related Technology--.

On page 1, line 8, change "Usually" to --Typically--.

On page 1, delete line 23.

On page 2, line 27, before "Fig. 1" insert --See--.

On page 3, delete line 12.

On page 4, line 6, change "published in:" to --See--.

On page 4, delete line 21.

On page 4, before line 24, insert --Summary of the Invention--.

On page 4, line 24, change "The object" to --An object--.

On page 4, delete line 30.

On page 5, line 1, change "in the invention described here" to --according to the present invention--.

On page 6, line 1, change "part of the" to --aspect of the present--.

On page 6, delete line 26.

On page 6, before line 28, insert --

Brief Description of the Drawings

Fig. 1. shows a flow chart depicting a prior art calculation of a quality value;

Fig. 2a shows a flow chart depicting a calculation of a quality value using a spectral weighting function;

Fig. 2b shows a flow chart depicting a calculation of a quality value using an inverted spectral weighting function; and

Fig. 3 shows a flow chart depicting a calculation of a Telecommunication Objective Speech Quality Assessment (TOSQA) using a spectral weighting function.

Detailed Description--.

On page 6, line 28, change "A special exemplary embodiment is shown by an implementation according" to --An embodiment of the present invention is now described with reference--.

On page 6, line 29, after "which" insert --shows a flowchart depicting a calculation of a so-called-- and delete "is known as".

On page 7, line 3, change "In specification of" to --Following-- and change "2b, speech" to --2b, but with more specificity, reference speech signal 2 and the speech signal to be assessed 4 are segmented (see blocks 6 and 8, respectively). Speech--.

On page 7, line 4, after "detector" insert --(see block 10)--.

On page 7, line 5, delete both occurrences of "the", after "reference speech signal" insert --2-- and after "assessed" insert --4--.

On page 7, line 6, after "filter" insert --(see blocks 14 and 16, respectively)--.

On page 7, line 7, change "handset." to --handset (see blocks 18 and 20, respectively). The weighting function $W_T(f)$ is applied to the reference speech signal before the bandpass filtering (see block 12).--.

On page 7, line 9, after "loudness" insert --(see blocks 22 and 24, respectively)--.

On page 7, line 17, after "1982)" insert --, which is hereby incorporated by reference herein--.

On page 7, line 20, after "function" insert --(see block 26)-- and after "value" insert --TOSQA--..

On page 7, line 22, after "segments" insert --(see block 28)--.

On page 8, line 1, change "Patent Claims" to --WHAT IS CLAIMED IS:--.

IN THE CLAIMS

Please cancel without prejudice claims 1-6 and add new claims 7-14 as follows:

--7. (new) A method for determining speech quality using an objective measure, the method comprising:

calculating a speech quality characteristic value by comparing respective spectral short-time properties of an assessed speech signal and of a reference speech signal;

prior to the comparing the respective spectral short-time properties, reducing differences in respective mean spectral envelopes of the assessed speech signal and of the reference speech signal by weighting spectral short-time properties of the assessed speech signal and the reference speech signal in a predetermined number of time segments using a spectral weighting function so as to include differences in the respective mean spectral envelopes in the speech quality characteristic value to a limited extent, the spectral weighting function being calculated from the respective mean spectral envelopes; and

calculating a respective intensity value for each of a plurality of frequency bands in a signal segment respectively for the assessed speech signal and the reference speech signal using variable limits for the frequency bands so that a respective difference between each calculated respective intensity of the assessed speech signal and the reference speech signal is reduced.

8. (new) The method as recited in claim 7 wherein the respective difference between each calculated respective intensity of the assessed speech signal and the reference speech signal is a respective minimum.

9. (new) The method as recited in claim 7 further comprising, before the reducing the differences in the respective mean spectral envelopes and the calculating the respective intensity, calculating the respective mean spectral envelopes of the assessed speech signal and the reference speech signal in the form of respective mean power density spectra and wherein the calculating of the spectral weighting function is performed using respective quotients of the respective mean power density spectra and wherein a short-time power density spectrum of the reference speech signal is weighted with the spectral weighting function before calculating the speech quality characteristic value.

10. (new) The method as recited in claim 7 further comprising, before the reducing the differences

in the respective mean spectral envelopes and the calculating the respective intensity, calculating the respective mean spectral envelopes of the assessed speech signal and the reference speech signal in the form of respective mean power density spectra and wherein the calculating of the weighting function is performed for partial regions of the calculated respective mean spectral envelopes so that the reducing differences in the mean spectral envelopes occurs only in partial spectral regions.

11. (new) The method as recited in claim 7 wherein the calculating of the respective intensity value for each of the plurality of frequency bands is performed before the calculating the quality characteristics value and is performed by integrating a respective signal intensity, the width of the frequency bands being constant on a pitch scale and further comprising calculating a respective specific loudness from the respective intensity values in the respective frequency bands, the limits for the frequency bands being selected so that differences in the calculated respective specific loudnesses between the assessed signal and the reference speech signal are a respective minimum in each frequency band in the signal segment.

12. (new) The method as recited in claim 7 wherein the calculating of the speech quality characteristic value is performed based on a similarity of respective spectral representations of the assessed speech signal and the reference speech signal in a plurality of time segments, the respective similarity representing a respective correlation coefficient between the respective spectral representations of the assessed speech signal and the reference speech signal in a respective time segment of the plurality of time segments averaged over the plurality of time segments.

13. (new) The method as recited in claim 12 wherein the respective spectral representations include the respective spectral short-time properties.

14. (new) The method as recited in claim 12 wherein the respective correlation coefficient is calculated from a subset of the respective spectral representations--.

IN THE ABSTRACT

Please delete lines 1-8.

Line 9, change "rates, are erroneously evaluated. In" to --In a method for determining speech quality using an objective measure, in--.

Line 11, delete "On".

Line 12, change "the other hand," to --Additionally--.

REMARKS

This Preliminary Amendment cancels original claims 1-6 and adds new claims 7-14. The new claims do not add new matter to the application but do conform the claims to U.S. Patent and Trademark Office rules.

The amendments to the specification, abstract and drawings are to conform the specification, abstract and drawings to U.S. Patent and Trademark Office rules. It is respectfully submitted that the amendments to the specification, abstract and drawings do not introduce new matter into the application.

The underlying PCT application includes a Search Report, a copy of which is included herewith.

Conclusion

Consideration of the present application as amended is hereby respectfully requested.

Respectfully Submitted,

Kenyon & Kenyon

Dated: 4/27/00

By: R. L. Mayer

Richard L. Mayer

(Reg. No. 22,490)

One Broadway
New York, NY 10004
Tel. (212) 425-7200
Fax. (212) 425-5288

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[2345/127]

METHOD FOR DETERMINING SPEECH QUALITY USING OBJECTIVE MEASURES

Preliminary Remarks

The invention relates to a method for determining speech quality using objective measures, in which characteristic values for determining speech quality are derived by comparing properties of a speech signal to be assessed to properties of a reference speech signal (undisturbed signal).

Usually, the quality of speech signals is determined through auditory ("subjective") tests by test persons.

The aim of objective methods for determining speech quality is to ascertain, with the aid of suitable calculation methods, characteristic values from the properties of the speech signal to be assessed, the characteristic values describing the speech quality of the speech signal to be assessed, without having to resort to the judgments of test persons.

The calculated characteristic values and the underlying method for determining speech quality using objective measures are regarded as acknowledged if a high correlation with the results of auditory reference tests is achieved. Consequently, the speech-quality values obtained by auditory tests represent the target values which are to be achieved by objective methods.

Related Art

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Known methods for determining speech quality using objective measures are based on a comparison of a reference speech signal to the speech signal to be assessed. In this context, the reference speech signal and the speech signal to be assessed are segmented into short time segments. The spectral properties of the two signals are compared in these segments.

Various approaches and models are used to calculate the spectral short-time properties. Generally, the signal intensity is calculated in frequency bands whose width becomes greater with increasing mid-frequency. Examples of such frequency bands are the known third-octave bands or frequency groups according to Zwicker (published in Zwicker, E.: "*Psychoakustik*" ["Psychoacoustics"], Berlin: Springer Publishing House, 1982).

The spectral intensity representation thus calculated for each time segment considered can be viewed as a series of numerical values, in which the number of individual values corresponds to the number of frequency bands used, the numerical values themselves represent the calculated intensity values, and a consecutive index of the frequency bands describes the sequence of the numerical values.

In the methods presently known for determining speech quality using objective measures, the limits of the frequency bands utilized are kept constant on the frequency axis.

In each time segment under consideration, the calculated intensities of the speech signal to be assessed and of the reference speech signal are compared to each other in each band. The difference of both values, or the similarity of the two resulting spectral intensity representations, constitutes the basis for the calculation of a quality value (Fig. 1).

Such methods were developed in particular for the qualitative assessment of speech in telephone applications. Examples thereof are the publications:

"*A perceptual speech-quality measure based on a psychacoustic sound representation*" (Beerends, J. G.; Stemerdink, J. A., J. Audio Eng. Soc. 42(1994)3, pp. 115-123)

"*Auditory distortion measure for speech coding*" (Wang, S; Sekey, A.; Gersho, A.: IEEE Proc. Int. Conf. acoust., speech and signal processing (1991), pp.493-496).

The presently valid ITU-T standard P.861 likewise describes such a method: *"Objective quality measurement of telephone-band speech codecs*" (ITU-T Rec. P.861, Geneva 1996).

Disadvantages of Known Objective Speech-Quality Measurement Methods

The use of known methods for determining speech quality using objective measures fails with respect to the reliability of the calculated quality values for certain signal properties to be assessed. Presently known methods furnish only unreliable quality values in particular when the speech signal to be assessed is impaired, such as in the case of impairments caused by speech coding methods with low bit rates or combinations of different disturbances.

In such cases, the presently known methods have the disadvantage that, given a comparison between the speech signal to be assessed and a reference speech signal, the quality characteristic value to be calculated includes differences between the two signal segments in the selected representation plane which either do not lead or scarcely lead to a qualitative impairment, not even one which is perceptible in the auditory test.

Within the framework of the transmission of speech in telephone applications that is being discussed here, frequency-band limitations and spectral deformations of the speech signal to be assessed (caused, for example, by filter properties of the telephone device or of the transmission channel) contribute only to a limited extent to a perceived qualitative

impairment.

To partially prevent such deficiencies, an attempt is made in a different approach to compensate for the linear distortions (frequency response) by a correction filter or a power-transmission function (published in: "*A new approach to objective quality-measures based on attribute-matching*", Halka, U.; Heute, U., Speech communication, 11(1992)1, pp.15-30). However, the use of this method is disadvantageous in the case of nonlinear and time-invariant transmission, since the compensation function thus calculated no longer exclusively describes the spectral deformations of the signal to be assessed.

In known methods, displacements of spectral short-time maxima ("formant displacements") in the signal under test in relation to the reference speech signal caused, for example, by coding systems with low bit rates, lead to large differences in the spectral intensity representations and therefore have a great influence on the calculated quality value. However, investigations have revealed that, in an auditory speech-quality test, these displacements of spectral short-time maxima have only a limited influence on the quality judgment.

Object

The object of the invention is to reduce the influence of spectral limitations and deformations of the speech signal to be assessed, as well as the influence of displacements of spectral short-time maxima, prior to comparing the spectral properties of a signal to be tested to a reference speech signal, and prior to the calculation of a quality value using objective methods.

Achievement

In contrast to known approaches, in the invention described here, a spectral weighting function is generated which is based on mean spectral envelopes, e.g., the mean spectral power density, of the speech signal to be assessed and the reference speech signal. This permits the use of the method in the case of nonlinear and time-variant transmission as well.

The spectral weighting function is calculated from the quotients of the given values of the mean spectral power density of the signal to be assessed $Phi_y(f)$ and that of the input signal of the transmission system $Phi_x(f)$, such that the weighting function can be described via

$$W_T(f) = a(f) \cdot (Phi_y(f) / Phi_x(f)).$$

The assessment function a(f) can weight the weighting function $W_T(f)$ differently over the range of effect, being constant at 1 in the simplest case.

The spectral weighting function $W_T(f)$ thus calculated brings the mean spectral envelopes of the speech signal to be assessed and the reference speech signal closer to each other, so that differences of the two spectral envelopes are included only to a reduced extent in the calculated quality value.

The spectral weighting function $W_T(f)$ can be applied, firstly, to the reference speech signal. In this context, the reference speech signal, in its mean spectral power density, is made to approximate the signal to be assessed (Fig. 2a).

Secondly, the spectral weighting function can be applied, inverted, to the signal to be assessed. The distortion of the latter is thereby eliminated and, with regard to its mean spectral power density, it is made to approximate the reference speech signal (Fig. 2b).

A further part of the invention relates to the correction of displacements of spectral short-time maxima which are caused by the transmission systems.

The intensity is integrated for each time segment in frequency bands. The result is a series of intensity values for each spectral representation of a signal segment, each individual value representing the intensity in a frequency band. In this connection, the displacements of spectral short-time maxima may lead to different calculated intensities in the frequency bands of the reference speech signal and the speech signal to be assessed.

These differences in the spectral intensity representations - caused by displacements of spectral short-time maxima - can be reduced by a variable arrangement of the frequency bands on the frequency axis. In contrast to the constant band limits in known methods, the band limits are displaced on the frequency axis. However, the number of frequency bands and their index remain constant. In an optimization loop, those band limits are then accepted at which the two resulting spectral representations of speech signal to be assessed and reference speech signal exhibit maximum similarity, or whose difference is minimal. This optimization is carried out for all bands in all time segments under consideration.

The use of variable band limits to calculate the spectral intensity representation is not restricted only to the signal in which the described spectral weighting function $W_T(f)$ is also used, but may also be applied to the other respective signal and even to both signals (see Fig. 2a and 2b).

Exemplary Embodiment:

A special exemplary embodiment is shown by an implementation according to Fig. 3, which is known as TOSQA (Telecommunication Objective Speech Quality Assessment). In this case, an expanded preprocessing of the reference speech signal is carried out.

In specification of the general implementations according to Fig. 2a and 2b, speech pauses are detected here by a speech-pause detector and are not included in the quality measure. Likewise, the reference speech signal and the speech signal to be assessed are filtered with

a 300 ... 3400 Hz bandpass filter, and there is also filtering to the frequency response of a telephone handset. The integration of the spectral power density is carried out in frequency groups which represent the basis for the calculation of the specific loudness.

However, the integration in frequency groups is *not* carried out in fixed frequency-group limits, but with the variable frequency-group limits described in the present invention. The calculated signal powers in the frequency groups thus modified form the basis for the intensity calculation. Use was made here of a model for calculating the specific loudness according to Zwicker, an aurally compensated intensity representation (published in Zwicker, E.: "*Psychoakustik*" ["Psychoacoustics"], Berlin: Springer Publishing House, 1982).

As an addition to the general approach, the calculated loudness patterns are supplemented by an error assessment function. The calculated quality value is formed via a mean value of the correlation coefficients of the specific loudness for each short time segment under consideration over the number of evaluated speech segments.

Patent Claims

1. A method for determining speech quality using objective measures, in which characteristic values for determining speech quality are calculated by comparing spectral short-time properties of a speech signal to be assessed to a reference speech signal, characterized in that, prior to comparing the properties of the speech signals, differences in mean spectral envelopes are reduced by first calculating from them a spectral weighting function with which the spectral short-time properties of the speech signals in all time segments under consideration are weighted, so that the differences in the mean spectral envelopes are thereby included only to a limited extent in the quality characteristic value to be calculated; and that the limits of the frequency bands used are made variable for calculating the signal intensity, so that, for each signal segment under consideration in all evaluated frequency bands, the calculated intensities of the reference speech signal and the signal to be assessed differ as little as possible from each other.

2. The method as recited in Claim 1,
characterized in that, first of all, the mean spectral envelopes of the speech signal to be assessed and the reference speech signal are calculated in the form of a mean power density spectrum, and a spectral weighting function $W_T(f)$ is calculated from the quotients of both spectra, the short-time power density spectra of the reference speech signal being weighted with said spectral weighting function $W_T(f)$ prior to calculating a quality characteristic value.

3. The method as recited in Claims 1 and 2,
characterized in that the weighting function $W_T(f)$ to be calculated is calculated only from partial regions of the calculated mean spectral envelopes of the speech signal to be assessed and the reference speech signal and, consequently, the differences in mean spectral envelopes between both signals are reduced only in partial spectral regions.

4. The method as recited in Claims 1 through 3, characterized in that, prior to

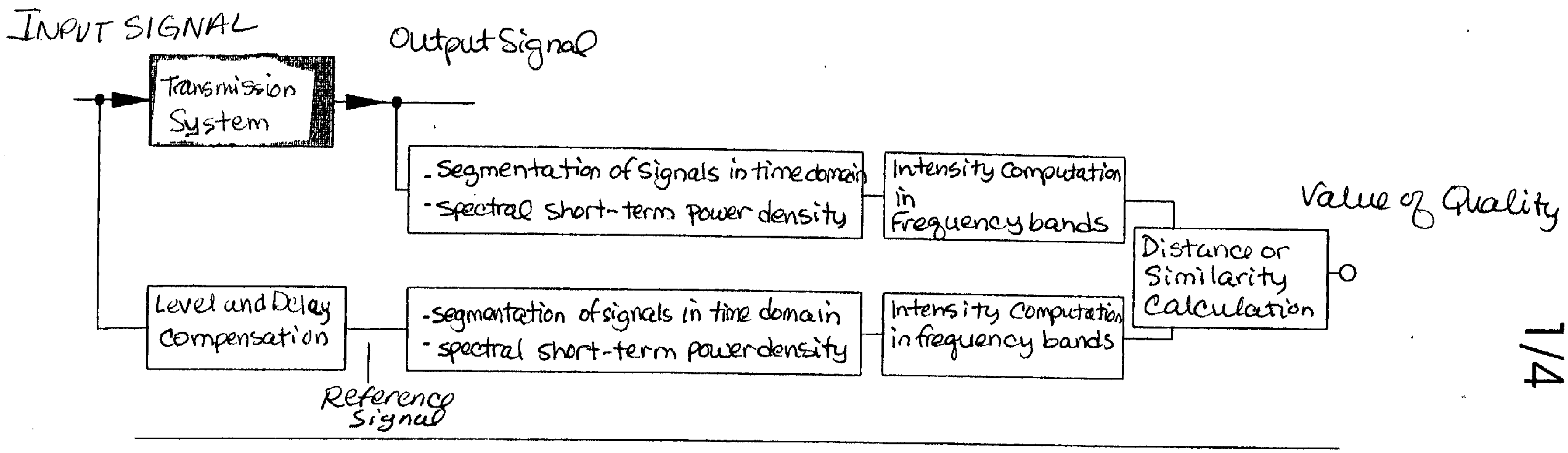
calculating the quality characteristic values, there is an integration of the signal intensity for each evaluated short time segment in frequency groups, the limits of the frequency groups being variable on the frequency axis, but the width of the frequency groups remaining constant on the pitch scale, and that the specific loudness is calculated from the signal intensities in the frequency groups, the limits of those frequency groups being used in which the calculated differences in the specific loudness between the signal to be assessed and the reference speech signal exhibit the smallest difference in the band and time segment under consideration.

5. The method as recited in Claims 1 through 4, characterized in that the quality characteristic value is calculated from the similarity of the spectral representations in each time segment under consideration, the similarity representing a correlation coefficient, averaged over all time segments under consideration, between the spectral representation of the speech signal to be assessed and the spectral representation of the reference speech signal in the respective time segment.

6. The method as recited in Claim 5,
characterized in that the correlation coefficient between the spectral representation of the speech signal to be assessed and the spectral representation of the reference speech signal in the respective time segment is calculated from only a partial region of the spectral representation, i.e. not all calculated spectral values are taken into consideration for the calculation of the quality characteristic value.

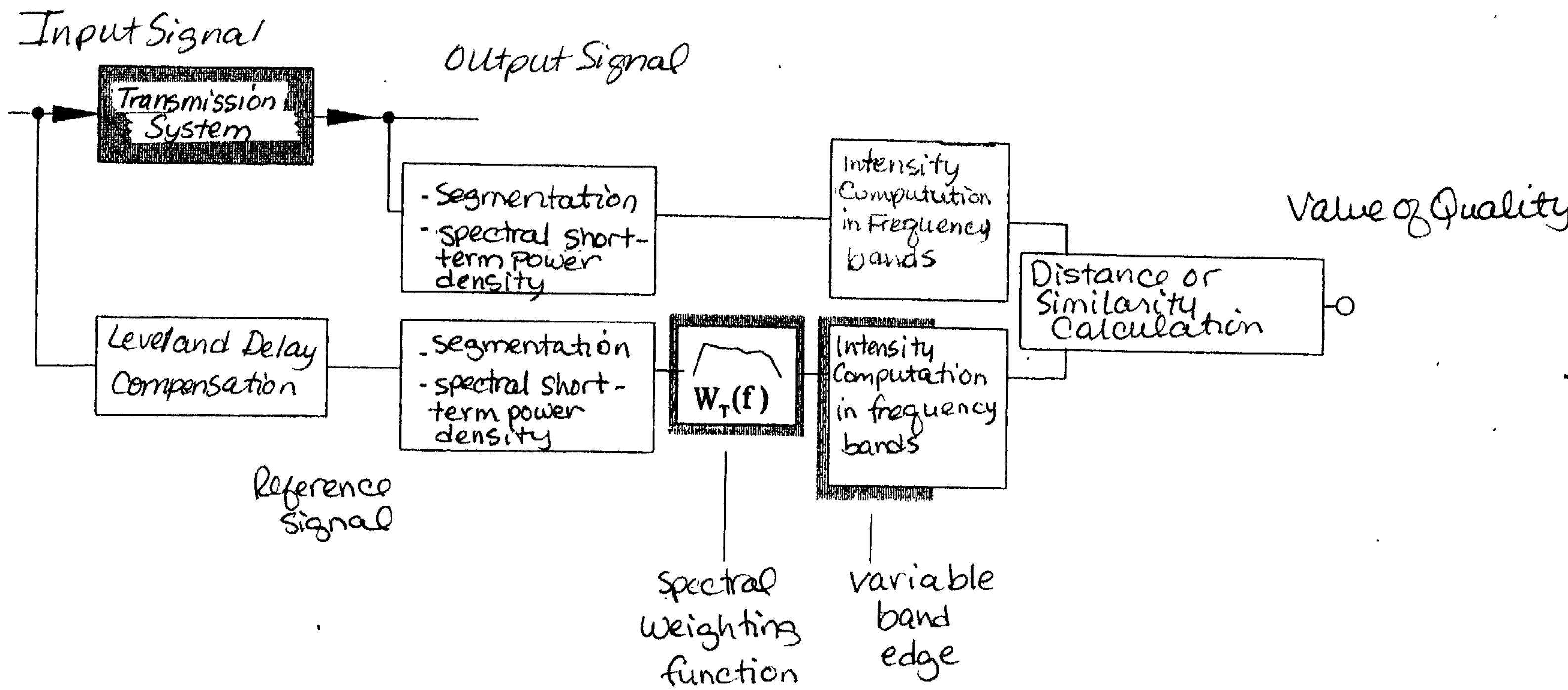
Abstract

Known methods for instrumental voice quality evaluation based on comparing signal intensities of the voice signal to be evaluated with a reference voice signal do not optimally evaluate spectral distortions in the voice signal to be evaluated so that quality evaluation is unreliable. Moreover, by integrating the signal intensity in the frequency bands with constant band limits, certain falsifications of the voice signal to be evaluated, such as those caused, for instance, by coding systems with lower bit rates, are erroneously evaluated. In order to enhance prediction reliability of the evaluated quality parameters, distortions of the mean spectral envelope are extensively corrected with a weighting function $W_T(f)$ before comparing spectral properties. On the other hand, the fixed band limits for integration of spectral power density are suppressed and other band limits are searched for instead in a predetermined optimization area in which the resulting spectral intensity representations of the voice signal to be evaluated and the reference voice signal have maximum similarity. The solutions described can supplement known methods and can be incorporated into their structures.



STATE OF THE ART

FIG. 1



Input Signal
Transmission System
Output Signal
- Segmentation
- spectral short-term power density
Intensity Computation in Frequency bands
Value of Quality
Distance or Similarity Calculation
Level and Delay Compensation
- Segmentation
- spectral short-term power density
$W_T(f)$
Intensity Computation in frequency bands
Reference signal
Spectral weighting function
variable band edge

FIG. 2a

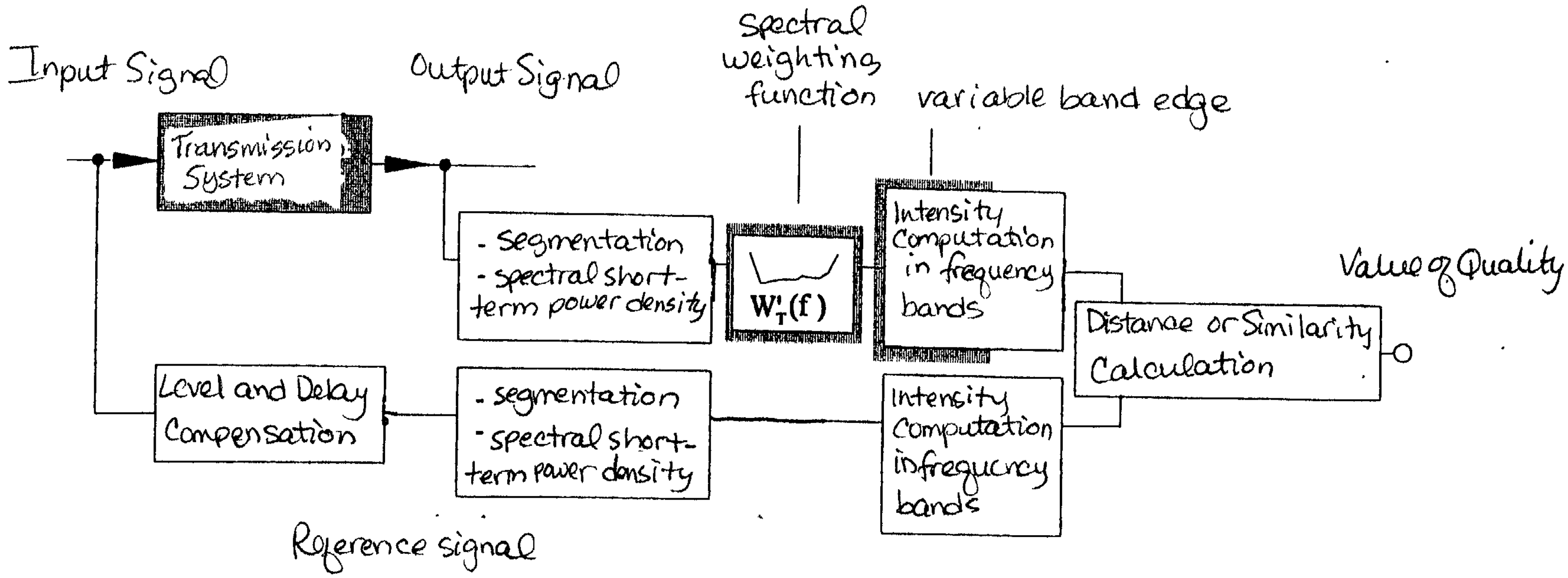

Input Signal
Transmission System
Output Signal
- segmentation
- spectral short-term power density
Spectral weighting function
$W'_T(f)$
variable band edge
Intensity Computation in frequency bands
Distance or Similarity Calculation
Value of Quality
Level and Delay Compensation
- segmentation
- spectral short-term power density
Intensity Computation in frequency bands
Reference signal

FIG. 2b

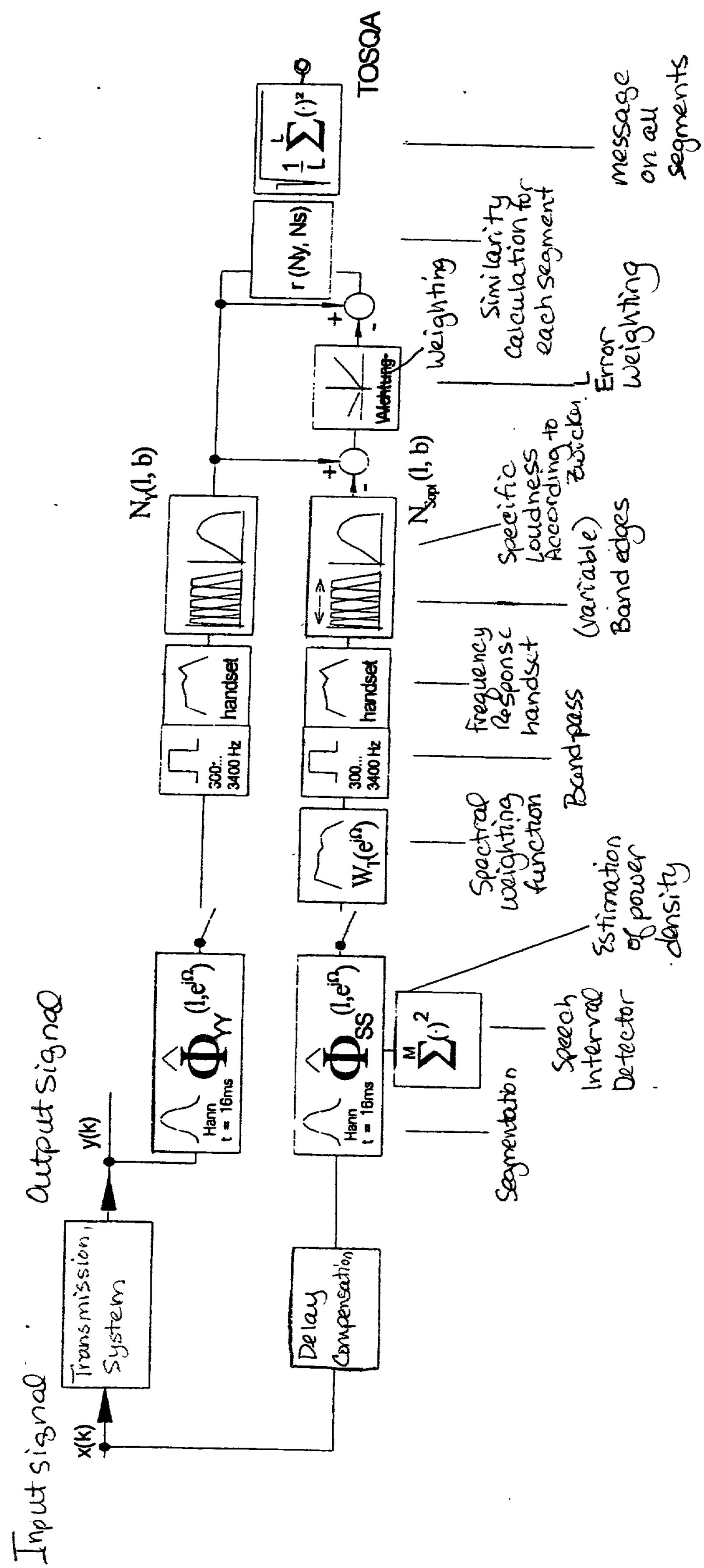

Input signal
x(k)
Transmission System
y(k)
Output signal
Delay Compensation
Hann t = 16ms
$\hat{\Phi}_{YY}(l,e^{j\Omega})$
$\hat{\Phi}_{SS}(l,e^{j\Omega})$
$\sum^{M}(\cdot)^2$
$W_T(e^{j\Omega})$
300... 3400 Hz
handset
$N_Y(l,b)$
$N_{Sqx}(l,b)$
+
-
Wichtung
Weighting
$r(N_Y, N_S)$
$\frac{1}{L}\sum^{L}(\cdot)^2$
TOSQA
Segmentation
Speech Interval Detector
Estimation of power density
Spectral weighting function
Band-pass
Frequency Response handset
(variable) Band edges
Specific loudness According to Zwicker
Error weighting
Similarity calculation for each segment
message on all segments

FIG. 3

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	
DECLARATION AND POWER OF ATTORNEY	ATTORNEY'S DOCKET NO. **2345/127**

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name,

I believe I am an original, first, and joint inventor of the subject matter that is claimed and for which a patent is sought on the invention entitled **METHOD FOR INSTRUMENTAL VOICE QUALITY EVALUATION**, the specification of which was filed as International Application No. **PCT/EP99/05972** on **14 August 1999**.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

PRIOR FOREIGN APPLICATION(S)

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. § 119
Germany	**198 40 548.0**	**27 August 1998**		**YES**

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorneys:
Richard L. Mayer (Reg. No. 22,490)
Erik R. Swanson (Reg. No. 40,833)

SEND CORRESPONDENCE, AND DIRECT TELEPHONE CALLS TO:

Richard L. Mayer
KENYON & KENYON
One Broadway
New York, New York 10004
(212) 425-7200 (phone)
(212) 425-5288 (facsimile)

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I declare that all statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

FULL NAME OF INVENTOR	FAMILY NAME **BERGER**	FIRST GIVEN NAME **Jens**	SECOND GIVEN NAME
RESIDENCE & CITIZENSHIP	CITY & ZIP CODE DEX **D-10405 Berlin**	STATE OR FOREIGN COUNTRY **Germany**	COUNTRY OF CITIZENSHIP **Germany**
POST OFFICE ADDRESS	POST OFFICE ADDRESS **Raabestrasse 8**	CITY & ZIP CODE **D-10405 Berlin**	STATE OR FOREIGN COUNTRY **Germany**
Signature		Date MARCH, 31st 2000	

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